REMARKS

Applicant hereby expresses appreciation to the Examiner for providing a detailed explanation of the reasons for the rejectionS.

Reconsidération is respectfully requested of the rejection of claims 1-8 under 35 U.S.C. § 112, first pargraph, as failing to comply with the written description requirement. In particular, the Examiner concludes that "lithium hexahydridoborane or lithium hexahydridoalane" are not described in the specification sufficiently to show that applicant had possession of these compounds at the time of the invention

It is respectfully submitted that the chemical literature discloses the chemical synthesis (Attachment A hereto), the mechano-chemical synthesis (Attachment B hereto); and properties of lithium hexahydridoalane (Attachment C hereto).

It is also respectfully submitted that one of ordinary skill in the art with the above literature before them concerning synthesis of lithium hexahydridoalane would use the same synthesis route to make lithium hexahydridoborane. While there is not a CAS reference to lithium hexahydridoborane, Cotton and Wilkinson's text "Inorganic Cheistry, IC indicates its existence, and its probable synthesis by substitution chemistry similar to lithium hexahydridoalane.

It is therefore respectfully urged that one of ordinary skill

in the art would understand when reading the written description in the present application and the known literature concerning lithium hexahydridoborane and lithium hexahydridoalane that at the time of the invention applicant was in possession of the invention. Accordingly, it is respectfully submitted that the present application fully complies with 35 U.S.C. 112, first paragraph. Withdrawal of the rejection is accordingly respectfully requested.

Reconsideration is respectfully requested of the rejection of claims 1-8 under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. In particular, the Examiner argues that one of ordinary skill in the art would not be able to determine what compositions meet the terms "lithium hexahydridoborane" or "lithium hexahydridoalane" without undue experimentation.

As shown in Attachments A-C, these compounds are adequately described in scientific and journal articles, including the properties of lithium hexahydridoalane (Attachment D). It is therefore respectfully submitted that the present application fully complies with the enablement requirement of 35 U.S.C. 112, first paragraph. Withdrawal of the rejection is accordingly requested.

Reconsideration is respectfully requested of the rejection of claims 1-8 under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Schumacher, et

al.

As the Examiner correctly points out, Schumacher, et al. disclose conventional fuels such as lithium, aluminum, and boron hydrides encapsulated in a solid propellant with ammonium perchlorate and polystyrene.

Applicant respectfully submits that one of ordinary skill in the art would undertand that many of these elements disclosed as fuels in Schumacher, et al., such as aluminum, lithium, boron, and magnesium, at the standard state, have a heat of formation of zero. Further, one of ordinary skill in the art would also understand that the solid hydrides of Schumacher, et al. have relatively high negative heat of formation values.

As discussed in the specification herein on pages 1 and 2, conventional solid propellants having aluminum therein leads to two-phase flow. That is, unreacted aluminum can emerge from the rocket nozzle with a commensurate decrease in thrust. Even when the particle size of the aluminum is reduced to minimize this phenomenon of two-phase flow, a passive oxide layer is immediately formed on the aluminum particles. It follows that the aluminum particles with the oxide coating are destroyed within the combustion chamber, resulting in a loss of energy by the subsequent "after-burning".

In contrast, the present invention provides a high energy

solid propellant containing a fuel with a positive heat of formation which provides a very high flame temperature in the combustion process. In particular, lithium hexahydridoalane has a positive heat of formation of +111.4 kcal/mol. The use of very high combustion temperatures minimizes the effect of two-phase flow losses in which aluminum liquid plates out on the nozzle of the solid rocket motor.

As indicated above, conventional propellants such as those disclosed by Schumacher, et al., when used in conjunction with aluminum result in two-phase flow.

Unobviousness can reside in the discovery of the cause of a problem, the solution of which employs a combination of old elements. *In re Spinnoble,* 160 USPQ 237 (CCPA, 1969), even though by hindsight the cause of the problem, once recognized, may suggest the solution. *In re Nomiya, et al.*, 184 USPQ 607 (CCPA 1975).

In the present case there is no disclosure whatever in Schumacher, et al. of a high energy solid propellant incorporating a fuel comprised of either lithium hexahydridoborane or lithium hexahydridoalane. Moreover, there is no disclosure in Schumacher, et al. of using in a solid propellant a fuel having a high positive heat of formation to produce a very high combustion temperature to minimize two-phase flow. On the contrary, that teaching or suggestion comes only from the present application and constitutes

an important element or aspect of the present invention.

It is respectfully submitted that applicant's discovery of a problem and solution thereof, i.e., applicant's focus on the two-phase flow and the solution to this problem to minimize plating out of aluminum liquid on the rocket nozzle constitutes a new and unobvious solution to this problem. For these reasons, it is respectfully submitted that the rejection fails, as a matter of law, in view of the above authorities. Consequently, the Examiner would be justified in no longer maintaining the rejection. Withdrawal of the rejection is accordingly respectfully requested.

In view of the foregoing, it is respectfully submitted that the application is now in condition for allowance, and early action and allowance thereof is accordingly respectfully requested. In the event there is any reason why the application cannot be allowed at the present time, it is respectfully requsted that the Examiner contact the undersigned at the number listed below to resolve any problems.

Respectfully submitted,

TOWNSEND & BANTA

Donald E. Townsend
Reg. No. 22,069

Customer No. 27955

Date: November 20, 2006

DOCKET NO. SWI-005-USA-P

TOWNSEND & BANTA
c/o FoundationIP
P.O. Box 52050
Minneapolis, MN 55402

CERTIFICATE OF MAILING

I hereby certify that this Response in Docket No. SWI-005-USA-P, Serial No. 10/712,340, filed November 14, 2003, is being deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to:

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

on November 20, 2006.

Donald E. Townsend

ATTACHMENT A

Chemical Synthesis

1. Ehrlich, Robert, Young, Archie R., II, Rice, George, Dvorak, Joseph, Shapiro, Philip, and Smith, Harry F., "The Chemistry of Alane. XI. A New Complex Lithium Aluminum Hydride, Li_3AlH_6," *Journal of the American Chemical Society*, Volume 88, Number 4, February 20, 1966, p. 858-860.
2. Ashby, E.C. and Goel, A.B., "Reactions of Phenyllithium with Lithium Aluminum Hydride in Diethyl Ether," *Journal of Organometallic Chemistry*, Volume 135, 1977, p. 137-144.
3. Chini, P., Baradel, A., and Vacca, C., "La reazione dell'alluminio con idrogeno e fluoruro potassico," *La Chimica E L'Industria*, Vol. 48, No. 6, Giugno 1966, p. 596-601.
4. Ashby, E.C. and James, B.D., "An Investigation of the Direct Synthesis of Group Ia Hexahydridoaluminates," *Inorganic Chemistry*, Volume 8, Number 11, November 1969, p. 2468-2472.

ATTACHMENT B

Mechano-Chemical Synthesis

1. Zaluski, L., Zaluska, A., and Strom-Olsen, J.O., "Hydrogenation Properties of Complex Alkali Metal Hydrides Fabricated by Mechano-Chemical Synthesis," *Journal of Alloys and Compounds*, Volume 290, 1999, p. 71-78.
2. Balema, V.P., Pecharsky, V.K., and Dennis, K.W., "Solid State Phase Transformations in $LiAlH_4$ During High-Energy Ball-Milling," *Journal of Alloys and Compounds*, Volume 313, 2000, p. 69-74.
3. Chen, Jun, Kuriyama, Nobuhiro, Xu, Qiang, Takeshita, Hiroyuki T., and Sakai, Tetsuo, "Reversible Hydrogen Storage via Titanium-Catalyzed $LiAlH_4$ and Li_3AlH_6," *Journal of Physical Chemistry*, Volume 105, B, 2001, p. 11214-11220.
4. Balema, Viktor P., Dennis, Kevin W., and Pecharsky, Vitalij K, "Rapid Solid-State Transformation of Tetrahedral $[AlH_4]^-$ into Octahedral $[AlH_6]^{3-}$ in Lithium Aluminohydride," *Chem. Comm.*, 2000, p. 1665-1666.
5. Konovalov, Sergei K. and Bulychev, Boris M., "The P,T-State Diagram and Solid Phase Synthesis of Aluminum Hydride," *Inorganic Chemistry*, Volume 34, 1995, p. 172-175.

ATTACHMENT C

Properties of LHA

1. Bureau, Jean-Claude, Amri, Zina, Claudy, Pierre, Letoffe, Jean-Marie, and Balland, Bernard, "Etude Comparative Des Hexahydrido-Et Des Hexadeuteridoaluminates De Lithium Et De Sodium. V - Conduction Electrique Dans Li_3AlH_6 Et Na_3AlH_6," *Materials Research Bulletin*, Volume 24, 1989, p. 653-660.
2. Bureau, Jean-Claude, Amri, Zina, Claudy, Pierre, and Letoffe, Jean-Marie, "Etude Comparative Des Hexahydrido-Et Des HexaDeuteridoaluminates De Lithium Et De Sodium. 1 – Spectres Raman Et Infrarouge De Li_3- Et Na_3AlH_6, Et Li_3AlD_6," *Materials Research Bulletin*, Volume 24, 1989, p. 23-31.

The RASCAL contract allowed us to develop as data sheet for LHA and to synthesize 15kg of the material for ballistic testing. The data sheet that we developed is shown below.

ATTACHMENT D

Lithium Hexahydridoalane (LHA)

Formula	Li_3AlH_6
Appearance	White powder
Physical Properties	Molecular Weight 53.852 Density 0.9591 g/cc Heat of Formation +111.4 kcal/mole Reactivity non-pyrophoric; ignites with water
Crystal System	Monoclinic
Interplanar Spacings	a: 7.036 b: 8.038 c: 5.668
Application	Energetic rocket fuel, hydrogen source, reducing agent.
Solubility	Reacts with water. No known solubility in other reagents.
Thermal Stability	Decomposes around 200°C with the production of hydrogen gas.
X-ray Powder Diffraction Primary Peaks	See table below
Toxicity/Safety Data	Flammable, corrosive. Follow MSDS guidelines for lithium aluminum hydride ($LiAlH_4$), CAS number 16853-85-3.
Handling/Storage/Disposal	Store and use only under inert, moisture-free atmosphere. Follow MSDS guidelines for lithium aluminum hydride ($LiAlH_4$), CAS number 16853-85-3.

X-ray Powder Diffraction Primary Peaks

2-theta Angle (°)	Intensity
22	125
31.5	80
34.6	45
38.3	76
39.5	42
44.3	33
45.3	32
50	35
51	37
60	27
60.5	25
61.8	22
65.4	17